July 2014

Unit 4 Test Review

Expectations
E1 - analyse technologies that use the wave nature of light, and assess their impact on society and the environment;
E2 - investigate, in qualitative and quantitative terms, the properties of waves and light, and solve related problems
E3 - demonstrate an understanding of the properties of waves and light in relation to diffraction, refraction, interference, and polarization.

Expectation E1

Explain fully

A. How has holographic technology made it more difficult to counterfeit Canadian currency?
B. In what ways does the use of lasers in surgery improve surgical techniques and recovery time?
C. In what ways can posting magazines or newsletters on the Internet, rather than printing and distributing them, benefit the environment?
D. How do geologists use the wave nature of light to find mineral deposits?
E. How do surface plasmon polaritons (SPPs) make use of the wave nature of light? What are some of the applications of SPPs?
F. How does the global positioning system (GPS) use the wave nature of light? What are its applications? What are its shortcomings?

Expectation E3

1.) Describe and explain the diffraction and interference of water waves in two dimensions.
2.) Explain how mirages are formed in a desert.
3.) Explain why we see different colours in a puddle of oil.
4.) Describe the setup of Young's Double Slit Experiment and explain the importance of this experiment to the development of our knowledge of light and physics in general.

Expectation E2

1.) Briefly describe what is meant by the following terms **[L3]**
    a. Nodal line
    b. Constructive Interference
    c. Filter
    d. Destructive interference
    e. Wavelength
    f. Standing wave
    g. Polarization

PROBLEM SOLVING

Question 1 [L3]

An interference pattern is formed on a screen when a helium-neon laser light ($\lambda=6.328\text{x}10^{-7}$ m) is directed towards it through two slits. If the slits are 43 μm apart and the screen is 2.5 m away, what will be the separation of adjacent nodal lines?

Question 2[L4]
A 5.0 Hz water wave, travelling at 31 cm/s in deep water, enters shallow water. The angle between the incident wave front in the deep water and the boundary between the deep and shallow regions is 50°. The speed of the wave in the shallow water is 27 cm/s. Find
(a) the angle of refraction in the shallow water
(b) the wavelength in shallow water

Question 3 [L4]
Two identical point sources 5.0 cm apart, operating in phase at a frequency of 8.0 Hz, generate an interference pattern in a ripple tank. A certain point on the first nodal line is located 10.0 cm from one source and 11.0 cm from the other. What is
(a) the wavelength of the waves?
(b) the speed of the waves?

Question 4 [L2]
Water waves traveling at a speed of 28 cm/s enter deeper water at an angle of 40 degrees. Determine the speed in the deeper water if the angle of refraction is 46 degrees.

Question 5 [L2]
The frequency of light is 3.80×10^{14} Hz. What is its wavelength in air, in nanometers?

Question 6 [L2]
A water wave has a wavelength of 2.0 cm in the deep section of a tank and 1.5 cm in the shallow section. If the speed of the wave in the shallow water is 12 cm/s, what is its speed in the deep water?